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ABSTRACT

A group of introductory college biology students using microscopic slides was compared to another group viewing photographic transparencies in addition to the microscopic slides. Students taught without the supplementary aids performed significantly better on examination questions dealing with the laboratory portion of the course. This unexpected result may have been caused by insufficient time available for students using transparencies to study all available materials, and a tendency for them to reduce the time spent on the actual microscopic slide items. (Author/CP)

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WSU-CORD

The Wisconsin State Universities Consortium of Research Development

Research Report

A COMPARATIVE STUDY OF TWO LABORATORY TEACHING METHODS

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Cooperative Research

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TABLE OF CONTENTS

SUMMARY.....1

INTRODUCTION.....1

MATERIALS AND METHODS.....2

RESULTS.....4

DISCUSSION.....4

LITERATURE CITED.....5

SUMMARY

Two methods of laboratory teaching were used in an introductory biology course in order to determine the most effective technique. For one group, 2 by 2 projection slides were used as visual aids to supplement microscope slide study. The second group received only the microscope slide materials, accompanied only by blackboard drawings. Only those examination questions concerned with the microscope slide study material were used as analysis items. Test scores of the two groups were subjected to an analysis of variance. The students that did not receive the projection slides as supplementary material did significantly better in the laboratory portion of the course than did those students receiving the accessory visual aids. This result was not anticipated on the basis of work in other courses with similar teaching aids. Observations indicated that the students in the experimental group may not have had sufficient time to make adequate study of the two types of materials and to make note of discussion items. Another possible factor to account for these results was that the students in the experimental group seemed to place more emphasis on the supplementary material than they did on the actual microscope slide items.

INTRODUCTION

The major concerns of biologists in the area of college teaching are those of course content and the sequence of topics in the individual courses. A number of factors are responsible for the state of flux in this area. First, there is the ever-present problem of keeping course content up to date. There is also the problem of integrating coursework and concepts in biology. The latter aspect has been responsible for the adaption of a core sequence of courses in many colleges. Another major concern is whether majors and non-majors should be placed together in one introductory course or whether there should be separate courses for the two groups. These areas are of major scope and are involved only indirectly in the present study.

There are also a number of immediate problems in the teaching of college biology. One of these involves the problems of teaching each individual course. New ideas and methods of teaching at the college level are slow to circulate among teachers of college biology courses. Also, there is no active literature in college biology teaching (Abell, 1969). Classroom teaching problems have been intensified by increases in student enrollment without corresponding staff increases. This creates more problems in laboratory teaching by increasing the number of students each instructor must supervise and direct. Sections of 30 students in laboratory sessions are far from unusual. Current trends in biology education have also increased teacher loads with the greater emphasis upon individualized student projects and experiences in the laboratory. It becomes more and more difficult for the instructor to provide attention and direction to individual students in the biology laboratory. Providing valuable laboratory experiences for the student is perhaps the most challenging portion of the introductory biology course (Bovbjerg, 1968). The role of the laboratory itself, in the introductory courses where non-majors are involved, is subject to dispute (Schein, 1967).

Some of the problems of the biology laboratory have been solved by the use of graduate students to supervise and teach the laboratory sections of the beginning courses. However, in the smaller colleges and universities there are usually insufficient numbers of graduate students to do much in solving this problem. Also, the policy in some state universities prevents placing graduate students in complete control of the laboratory sections; the instructor must be present at all times to supervise the graduate students. Maintaining a large degree of student-teacher contact is one of the major "selling points" of the smaller institutions. This tends to restrict the use of graduate students in the laboratory sections.

Two methods of meeting some of these problems have been met by the use of audio-tutorial methods in the laboratories and by the use of programmed study materials. While the audio-tutorial methods meet some of the problems of increased instructor loads (Surdy, 1966; Abell, 1968 and Wise, 1968), they still have some disadvantages and are not widely used in college biology teaching. The use of undergraduate students to aid in the preparation of materials and as teacher aids is a distinct help. Additional methods of increasing teacher efficiency in the laboratory are desperately needed. New methods are especially helpful if they can increase student learning at the same time.

The present study was conducted in order to test the relative effectiveness of two methods of studying microscope slide material in an introductory biology course. In general, the use of animal and plant dissection and of prepared slide material has been greatly de-emphasized by current trends in biology education. However, such slide study is still necessary in understanding certain areas of biology, such as the composition of vertebrate organs, tissues and cells. The use of microscope slide study material usually forms a portion of even the most "modern" introductory biology course (Hayes et al, 1968). Most introductory courses include study of the cell, cell reproduction, chromosomes and some material on animal and plant diversity. These areas of study require the use of either living or prepared slide material. These areas, and others, are a part of the introductory biology course at River Falls and laboratory exercises involving microscope slides are routinely used. Other areas where microscope slides are used in our introductory course include: microorganisms, vertebrate reproduction, blood and cell chemistry. In this project an attempt was made to increase teacher efficiency and to provide greater student understanding by the use of 2 by 2 color projection slides of the microscopic study material.

MATERIALS AND METHODS

The study group involved two laboratory sections of Biology 100 at Wisconsin State University--River Falls, during the fall quarter of 1969. At River Falls, non-science majors are required to take three science courses (biology, physics, chemistry, astronomy, mathematics or geology) in order to meet their science requirements of the "basic studies" program. Biology 100 meets this basic studies requirement. This is also the introductory course for biology majors and minors.

The course consists of two, one-hour lecture-discussion periods and one, two-hour laboratory period each week for a 12 week quarter. In the particular study group, two instructors were present in the lecture-discussion period and each instructor had two independent laboratory sections. There was no attempt to assign students to either of the two laboratory sections of this project; the groups were filled by individual student preference during registration. The first laboratory group met for laboratory each Wednesday from 10 AM until noon; the second group met on Thursdays for the same time interval. Lecture-discussion sessions were held on Mondays and Fridays at 10 AM.

The Wednesday group was selected at random as the experimental group (those which would receive supplementary visual aids corresponding to their microscopic slide study material). The Thursday group was the control group: those students which studied only the microscope slides (with only blackboard sketches by the instructor). One undergraduate biology major assisted in all the laboratory sessions of both groups. The instructor was present at all times in the laboratory.

A 70 point pretest was given in the first lecture period in order to test the biology background of all students. The mean for both groups was 21 points. Student ACT composite and natural science scores were also obtained. The mean ACT composite score for the experimental group was 20; for the control group it was 21. The mean ACT natural science score was 21 for the experimental group and 22 for the control group. It was believed that the students' scores on this latter test would give the best indication available of their natural ability in biology. While no difference between the two groups was suspected, an analysis of variance of the test scores was conducted. There was no significant difference (at the .05 level) between the two groups on this test.

The 2 by 2 projection slides (for the experimental group) were used only in conjunction with student study of microscope slide material. The major use of these visual aids was limited to the following laboratory exercises: Cells, Tissues and Organisms; Cellular Chemistry; Blood; Microorganisms; and Cell and Organism Reproduction.

All examinations in the course were given in the lecture-discussion periods. Thus, all students took identical examinations at the same time. Two students in the experimental group did not finish the course and one student did not take the final examination in the scheduled time (because of illness); these students were not considered in the project. The experimental group was composed of 29 students and the control group had 27. Three examinations were given in the quarter. Only those items specifically concerned with student microscope slide study material were used as measurement items. An analysis of variance was completed on test results in order to test the null hypothesis that there was no difference in student learning between the two methods of laboratory teaching. Statistical references were from Snedecor (1956).

RESULTS

Each of the three examinations given during the quarter contained ten items specifically dealing with microscope slide study material. The results of the two student groups on these items was subjected to an analysis of variance. This information is presented below:

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Groups	1	68	68
Treatment	4	69	17
Determinations	162	1239	7.7
Totals	167	1376	

There was a significant difference between the two groups (at the .05 level) with respect to the test results on the microscope slide items: the calculated F value of 68/7.7 = 8.83 as compared to the tabular F value of 3.91 (F 1, 162). However, it was the control group (without color slide visual aids) that achieved significantly better results than did the experimental group.

DISCUSSION

The 2 by 2 projection slides have been used as supplementary study material in a number of advanced biology courses (field biology, histology, parasitology and others). Student response has always been enthusiastic. There has been, however, no study conducted on their effectiveness in student learning. It was assumed that the use of projection slides in introductory courses would produce better understandings and retention by the students in their study of microscopic slide materials. The surprising results of this study point out the need for a reconsideration in the usage of 2 by 2 projection slides. Is there a difference in the effectiveness of this material between the two levels of instruction? As indicated by most of the Biology 100 students, this was their first work with individual slide study with the microscope. This could have affected the results in that the students did not have satisfactory study methods yet developed for slide work. Were the better results of control group due to inefficient usage of the visual aids by the instructor? Were the color slides a handicap to the students in that they interfered with their study of the microsocope slides? The investigator cannot believe that properly used visual aids of this type are detrimental to student study of microscope slides.

One factor that may have been of considerable importance was that of time. After the first laboratory period, in which the projection slides were used concurrently with the microscope slides for the experimental group, it seemed that the students did not have sufficient time to make observations on both the projected slides and the microscope slides, as well as taking some notes from the ensuing discussion. However, the

projected slides were generally used as introductory material prior to individual student study. Here, time should not have been a deciding factor.

The control group was the second laboratory period held during the week; the experimental group received the first presentation. This was the first time that the undergraduate student had assisted in this course. It is reasonable to assume that he was better prepared for the second group--the control group. However, since the laboratory presentation was given by the lab instructor, who had taught the same basic material twelve times in the past two years and who was senior author of the laboratory manual, it seems unlikely that the student assistant was responsible for the significant difference between the two groups.

The control group did consistently better work in all protions of the course (lecture-discussion examinations, other aspects of the laboratory work and textbook portions of the examinations) than did the experimental group. This tends to indicate that some other factor was responsible for the difference between the two groups. Unknowingly, the instructors may have stimulated more interest in the control group or may have had better rapport with this group. Additional studies are necessary in order to determine the most effective method of presenting microscopic slide study (with or without supplementary visual aids) in introductory biology courses.

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